Claims:

1. A method of filling a feature, comprising:

depositing a barrier layer;

depositing a seed layer over the barrier layer, the seed layer comprising copper and a metal selected from the group consisting of aluminum, magnesium, titanium, zirconium, tin, and combinations thereof; and

depositing a copper conductive material layer over the seed layer.

2. The method of claim 1, wherein the seed layer comprises a copper alloy seed layer of the copper and the metal.

3. The method of claim 1, wherein the seed layer comprises a first seed layer deposited over the barrier layer and a second seed layer deposited over the first seed layer.

4. The method of claim 3, wherein the first seed layer comprises a copper alloy seed layer of the copper and the metal.

5. The method of claim 4, wherein the second seed layer comprises undoped copper.

6. The method of claim 3, wherein the first seed layer comprises the metal.

7. The method of claim 6, wherein the second seed layer comprises undoped copper.

8. The method of claim 1, wherein the barrier layer is deposited by a technique selected from the group consisting of atomic layer deposition, chemical vapor deposition, physical vapor deposition, and combinations thereof.

9. The method of claim 1, wherein the seed layer is deposited by a technique selected from the group consisting of physical vapor deposition, chemical vapor deposition, atomic layer deposition, electroless deposition, and combinations thereof.

10. The method of claim 1, wherein the copper conductive material layer is deposited by a technique selected from the group consisting of electroplating, electroless deposition, chemical vapor deposition, physical vapor deposition, and combinations thereof.

11. A method of depositing a seed layer over a barrier layer for subsequent deposition of a conductive material layer over the seed layer, comprising:

depositing a copper alloy seed layer over the barrier layer, the copper alloy seed layer comprising copper and a metal in a concentration between about 0.001 atomic percent and about 5.0 atomic percent, the metal selected from the group consisting of aluminum, magnesium, titanium, zirconium, tin, and combinations thereof.

12. The method of claim 11, wherein the copper alloy seed layer comprises the metal in a concentration between about 0.01 atomic percent and about 2.0 atomic percent.

13. The method of claim 11, wherein the copper alloy seed layer comprises the metal in a concentration between about 0.1 atomic percent and about 1.0 atomic percent.

14. The method of claim 11, wherein the copper alloy seed layer is deposited by a technique selected from the group consisting of physical vapor deposition, chemical vapor deposition, atomic layer deposition, electroless deposition, and combinations thereof.

15. A method of depositing a seed layer over a barrier layer for subsequent deposition of a conductive material layer over the seed layer, comprising:

depositing a copper alloy seed layer over the barrier layer, the copper alloy seed layer comprising copper and a metal selected from the group consisting of aluminum, magnesium, titanium, zirconium, tin, and combinations thereof; and

depositing a second seed layer over the copper alloy seed layer.

16. The method of claim 15, wherein the second seed layer comprises undoped copper.

17. The method of claim 15, wherein the copper alloy seed layer comprises the metal in a concentration between about 0.001 atomic percent and about 5.0 atomic percent.

18. The method of claim 15, wherein the copper alloy seed layer comprises the metal in a concentration between about 0.01 atomic percent and about 2.0 atomic percent.

19. The method of claim 15, wherein the copper alloy seed layer comprises the metal in a concentration between about 0.1 atomic percent and about 1.0 atomic percent.

20. The method of claim 15, wherein the copper alloy seed layer is deposited by a technique selected from the group consisting of physical vapor deposition, chemical vapor deposition, atomic layer deposition, electroless deposition, and combinations thereof.

21. The method of claim 15, wherein the second seed layer is deposited by a technique selected from the group consisting of physical vapor deposition, chemical vapor deposition, atomic layer deposition, electroless deposition, and combinations thereof.

22. The method of claim 15, wherein the copper conductive material layer is deposited over the second seed layer.

23. A method of depositing a seed layer over a barrier layer for subsequent deposition of a conductive material layer over the seed layer, comprising:

depositing a first seed layer over the barrier layer, the first seed layer comprising a metal selected from the group consisting of aluminum, magnesium, titanium, zirconium, tin, and combinations thereof; and

depositing a second seed layer over the first seed layer.

24. The method of claim 23, wherein the second seed layer comprises undoped copper.

25. The method of claim 23, wherein the first seed layer is deposited to a sidewall coverage between a sub-monolayer and about 50 Å.

26. The method of claim 23, wherein the first seed layer is deposited to a sidewall coverage between a sub-monolayer and about 40 Å.

27. The method of claim 23, wherein the first seed layer is deposited by a technique selected from the group consisting of physical vapor deposition, chemical vapor deposition, atomic layer deposition, electroless deposition, and combinations thereof.

28. The method of claim 23, wherein the second seed layer is deposited by a technique selected from the group consisting of physical vapor deposition, chemical vapor deposition, atomic layer deposition, electroless deposition, and combinations thereof.

29. The method of claim 23, wherein the copper conductive material layer is deposited over the second seed layer.

30. A method of preparing a substrate structure for copper metallization, comprising:
depositing a barrier layer to a sidewall coverage of about 50 Å or less; and
depositing a seed layer over the barrier layer, the seed layer comprising copper and a metal selected from the group consisting of aluminum, magnesium, titanium, zirconium, tin, and combinations thereof.

31. The method of claim 30, wherein the barrier layer is deposited to a sidewall coverage of about 20 Å or less.

32. The method of claim 30, wherein the barrier layer is deposited to a sidewall of

about 10 Å or less.

33. The method of claim 30, wherein the seed layer comprises a copper alloy seed layer of the copper and the metal.

34. The method of claim 30, wherein the seed layer comprises a first seed layer deposited over the barrier layer and a second seed layer deposited over the first seed layer.

35. The method of claim 34, wherein the first seed layer comprises a copper alloy seed layer of the copper and the metal.

36. The method of claim 35, wherein the second seed layer comprises undoped copper.

37. The method of claim 34, wherein the first seed layer comprises the metal.

38. The method of claim 37, wherein the second seed layer comprises undoped copper.

39. The method of claim 30, wherein the barrier layer is deposited by a technique selected from the group consisting of atomic layer deposition, chemical vapor deposition, physical vapor deposition, and combinations thereof.

40. The method of claim 30, wherein the barrier layer comprises a material selected from the group consisting of titanium, titanium nitride, titanium silicon nitride, tantalum, tantalum nitride, tantalum silicon nitride, tungsten, tungsten nitride, tungsten silicon nitride, and combinations thereof.

41. The method of claim 30, wherein the seed layer is deposited by a technique selected from the group consisting of physical vapor deposition, chemical vapor deposition, atomic layer deposition, electroless deposition, and combinations thereof.

42. A method of filling a feature, comprising:

depositing a barrier layer;

depositing a copper alloy seed layer over the barrier layer, the copper alloy seed layer comprising copper and a metal in a concentration between about 0.01 atomic percent and 5.0 atomic percent, the metal selected from the group consisting of aluminum, magnesium, titanium, zirconium, tin, and combinations thereof; and

depositing a copper conductive material layer over the copper alloy seed layer.

43. The method of claim 42, wherein the barrier layer is deposited by a technique selected from the group consisting of atomic layer deposition, chemical vapor deposition, physical vapor deposition, and combinations thereof.

44. The method of claim 42, wherein the barrier layer comprises a material selected from the group consisting of titanium, titanium nitride, titanium silicon nitride, tantalum, tantalum nitride, tantalum silicon nitride, tungsten, tungsten nitride, tungsten silicon nitride, and combinations thereof.

45. The method of claim 42, wherein the copper alloy seed layer is deposited by a technique selected from the group consisting of physical vapor deposition, chemical vapor deposition, atomic layer deposition, electroless deposition, and combinations thereof.

46. The method of claim 42, wherein the copper conductive material layer is deposited by a technique selected from the group consisting of electroplating, electroless deposition, chemical vapor deposition, physical vapor deposition, and combinations thereof.

47. A method of filling a feature, comprising:

depositing a barrier layer by atomic layer deposition;

depositing a copper alloy seed layer over the barrier layer, the copper alloy seed layer comprising copper and a metal in a concentration between about 0.01 atomic percent and 5.0 atomic percent, the metal selected from the group consisting of aluminum, magnesium, titanium, zirconium, tin, and combinations thereof;

depositing a second seed layer over the copper alloy seed layer; and
depositing a copper conductive material layer over the second seed layer.

48. The method of claim 47, wherein the barrier layer comprises a material selected from the group consisting of titanium, titanium nitride, titanium silicon nitride, tantalum, tantalum nitride, tantalum silicon nitride, tungsten, tungsten nitride, tungsten silicon nitride, and combinations thereof.

49. The method of claim 47, wherein the second seed layer comprises undoped copper.

50. The method of claim 47, wherein the copper alloy seed layer is deposited by a technique selected from the group consisting of physical vapor deposition, chemical vapor deposition, atomic layer deposition, electroless deposition, and combinations thereof.

51. The method of claim 47, wherein the second seed layer is deposited by a technique selected from the group consisting of physical vapor deposition, chemical vapor deposition, atomic layer deposition, electroless deposition, and combinations thereof.

52. The method of claim 47, wherein the copper conductive material layer is deposited by a technique selected from the group consisting of electroplating, electroless deposition, chemical vapor deposition, physical vapor deposition, and combinations thereof.

53. A method of filling a feature, comprising:
depositing a barrier layer by atomic layer deposition;
depositing a first seed layer over the barrier layer to a sidewall coverage between a sub-monolayer and about 50 Å, the first seed layer comprising aluminum;
depositing a second seed layer over the first seed layer; and
depositing a conductive material layer over the second seed layer.

54. The method of claim 53, wherein the barrier layer comprises a material selected from the group consisting of titanium, titanium nitride, titanium silicon nitride, tantalum, tantalum nitride, tantalum silicon nitride, tungsten, tungsten nitride, tungsten silicon nitride, and combinations thereof.

55. The method of claim 53, wherein the second seed layer comprises undoped copper.

56. The method of claim 53, wherein the first seed layer is deposited by a technique selected from the group consisting of physical vapor deposition, chemical vapor deposition, atomic layer deposition, electroless deposition, and combinations thereof.

57. The method of claim 53, wherein the second seed layer is deposited by a technique selected from the group consisting of physical vapor deposition, chemical vapor deposition, atomic layer deposition, electroless deposition, and combinations thereof.

58. The method of claim 53, wherein the copper conductive material layer is deposited by a technique selected from the group consisting of electroplating, electroless deposition, chemical vapor deposition, physical vapor deposition, and combinations thereof.

59. A method of preparing a substrate structure for electroplating of copper, comprising:

depositing a barrier layer by atomic layer deposition; and

depositing a seed layer over the barrier layer, the seed layer comprising copper and aluminum.

60. The method of claim 59, wherein the seed layer comprises a copper alloy seed layer of the copper and the aluminum, the aluminum present in the copper alloy seed layer in a concentration between about 0.001 atomic percent and about 5.0 atomic percent.

61. The method of claim 60, wherein the copper alloy seed layer comprises the aluminum in a concentration between about 0.01 atomic percent and about 2.0 atomic percent.

62. The method of claim 60, wherein the copper alloy seed layer comprises the aluminum in a concentration between about 0.1 atomic percent and about 1.0 atomic percent.

63. The method of claim 59, wherein the seed layer comprises a first seed layer deposited over the barrier layer and a second seed layer deposited over the first seed layer.

64. The method of claim 63, wherein the first seed layer comprises a copper alloy seed layer of the copper and the aluminum, the aluminum present in the copper alloy seed layer in a concentration between about 0.001 atomic percent and about 5.0 atomic percent and wherein the second seed layer comprises undoped copper.

65. The method of claim 64, wherein the copper alloy seed layer comprises the aluminum in a concentration between about 0.01 atomic percent and about 2.0 atomic percent.

66. The method of claim 64, wherein the copper alloy seed layer comprises the aluminum in a concentration between about 0.1 atomic percent and about 1.0 atomic percent.

67. The method of claim 63, wherein the first seed layer comprises aluminum to a sidewall coverage between a sub-monolayer and about 50 Å and wherein the second seed layer comprises undoped copper.

68. The method of claim 59, wherein the barrier layer comprises a material selected from the group consisting of titanium, titanium nitride, titanium silicon nitride, tantalum, tantalum nitride, tantalum silicon nitride, tungsten, tungsten nitride, tungsten silicon nitride, and combinations thereof.

69. The method of claim 59, wherein the seed layer is deposited by a technique selected from the group consisting of physical vapor deposition, chemical vapor deposition, atomic layer deposition, electroless deposition, and combinations thereof.